Chapter 4 Sustainable management program development and implementation

4.1 Developing and implementing a management program

The purpose of this chapter is to assist local communities with creating and sustaining a management program for decentralized wastewater treatment systems, as an alternative or in addition to central sewers. The five program models outlined in this handbook describe a series of management levels, ranging from a scenario in which homeowners are reminded to maintain their septic tanks to one that resembles a typical sewer district where all necessary services are provided in return for a monthly or quarterly user fee paid by the homeowner. Higher levels of management are characterized by more comprehensive development of various program elements; (e.g., enhanced planning to identify system performance requirements, periodic inspections or monitoring).

Management programs can range from an informal network of private service providers, public agency staffs, and other partners operating under a coordinated framework to a highly structured entity founded specifically to own, operate, and maintain a defined set of treatment systems. The key objective in developing the program is to ensure that it reflects the community's best effort to deal with potential public health and water resource threats given the human, programmatic, and other assets available. Forging local resources into a viable management program is by definition a case-specific process, highly dependent upon the commitment, creativity, and cooperation of participants.

There are a number of critical ingredients for developing an effective and sustainable decentralized wastewater management program (Ciotoli and Wiswall, 1982; Mancl, 2001):

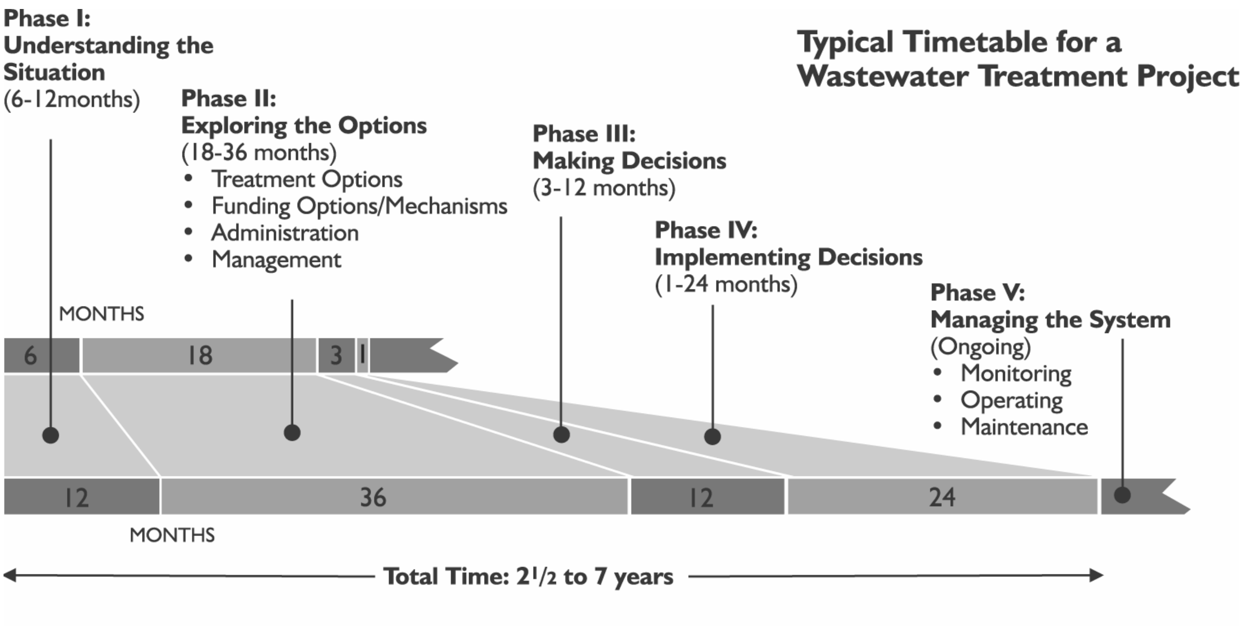
- Public acceptance and local political support
- Funding availability and/or reasonable costs
- Visibility and accountability of local leaders
- Capability and attitude of technical/field staff
- Availability of creative, professional advisors
- Clear and concise legal authority, regulations, and enforcement mechanisms

A successful management program development sequence follows these basic steps:

- Identify and engage stakeholders and interested parties
- Organize those involved through formal or informal processes
- Develop and implement a public education and outreach program
- Assess decentralized wastewater facilities and impacts
- Determine current trends regarding facilities and impacts
- Project future scenarios as indicated by the trends analysis
- Create a community vision incorporating preferred outcomes
- Conduct a reality check to determine availability of technical, financial, etc. resources
- Explore options under existing and/or revised regulatory structure(s)
- Select the preferred option(s), identify success indicators, and develop a work plan
- Implement the work plan; adapt as suggested by monitoring of success indicators

Realistically incorporating these key ingredients into a functional and sustainable management program is a difficult and slow process, Olson et al.. (2002) estimate to take 2.5 to 7 years (see Figure 4-1). But it is well worth the effort.

Figure 4-1. Typical timetable for a wastewater treatment project



Source: Olson et al 2002

Onsite system management services are provided through an identifiable program—a mix of institutions and procedures, developed through a process that consists of a series of phases, (i.e., initiation, planning, and implementation). Smaller communities with unpaid or part-time officials may develop management programs by coordinating existing resources and perhaps developing new capabilities or owner requirements as necessary. As noted by Allee, et al.., (1999), the process of enhancing system management entails building relationships among local policy or governing entities, informed regulatory staff, property owners, service providers, and citizens. Management programs that are more formalized and structured will follow a similar developmental process, but will likely include additional considerations such as program funding and staffing. All programs should:

- Have sufficient local support and legal authority
- Be flexible in adapting to changing demands
- Ensure reasonable homeowner costs
- Have the ability to achieve public health and environmental objectives

This chapter draws upon information presented in previous chapters pertaining to the five Management Models (see Chapter 3), the key program elements or components (see Chapter 2), and the necessary cooperative relationships and/or regulatory powers that must be considered in the development of all management programs. The approach discussed in this chapter focuses on how development of new or enhanced decentralized wastewater system management programs can be undertaken by creating partnerships, assessing health and environmental risks, and building consensus among stakeholders on program goals, preferred actions, and implementation.

Traditionally, local residents have been unwilling to commit funds and resources to address decentralized wastewater problems unless they are convinced that 1) a problem actually exists; 2) there are unacceptable consequences of not solving the problem; and 3) the relative costs can be accommodated. Therefore, involving stakeholders, other interested parties, and the public in the early stages of program development is paramount. Successful management programs are created by building capabilities, cooperation, and coordination among system users, service providers, and public agencies.

The implementation of any successful effort to manage decentralized systems is more dependent on the program development process than on the treatment technologies available (Olson, et al., 2002). Table 4-1 summarizes a generalized approach for tailoring a management program to a community's specific needs. This approach, which is similar to conventional watershed assessment/planning/management protocols used across the Nation, can be (and has been) adapted in any number of ways to meet the wastewater management needs of local communities.

Figure 4-2. Key attributes of the management concept

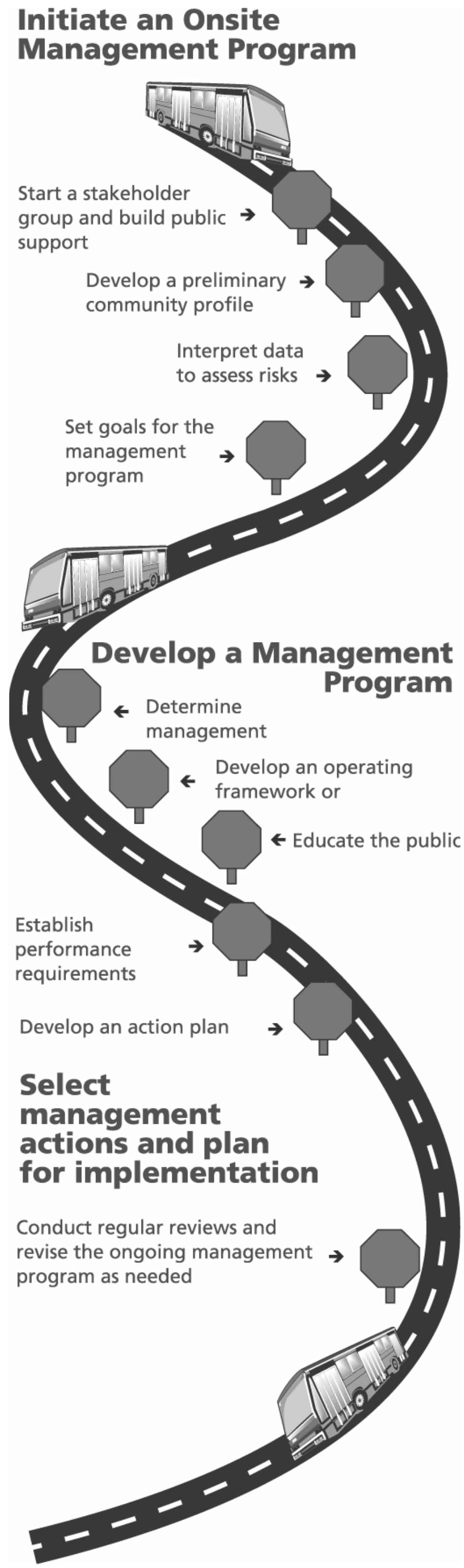
Table 4-1. General approach for developing and implementing a management program

Generalized steps	Examples of typical activities or processes
Convene interested parties and initiate education and outreach activities.	Identify key stakeholders (community and regulators) and other potential partners (e.g., planning departments, development companies, service providers, existing management entities). Develop a steering committee of key stakeholders to be responsible for defining the problems, assessing available information, involving the community, determining the feasibility of establishing a management program, and identifying its goals. Develop and implement education and outreach initiatives to publicize current issues and activities of the steering committee.
Identify and assess existing information to evaluate potential risks.	Inventory or otherwise collect information on existing systems and impacts i.e., explore development trends and relative uses and values of impacted receiving waters (i.e., drinking water source, recreational waters, shellfish habitat, aesthetic attributes). Analyze trends regarding new decentralized facilities and projected impacts. Consider applicable water quality standards, monitoring and assessment information, and relative vulnerability of water resources based on hydrogeologic, modeling, or other existing or new information. Based on trends analysis, estimate likely future impacts of onsite systems.
Identify, prioritize, and target key problem areas.	Conduct a community profiling and visioning process to identify the positive features about the community that should be preserved under any plan chosen. Ensure that the community is aware of the problems identified and the potential social and financial costs of traditional engineering solutions (central sewers) and the capabilities and costs of appropriately managed alternatives. Synthesize vulnerability, monitoring/assessment, and other information to identify and prioritize problem sites or areas. Conduct a reality check to determine the availability of technical, financial, and other resources.
Develop clear goals and explore options to address identified problems.	Investigate and identify resources needed to support remedial action or further study; establish performance requirements based on health and water resource assessment information. Evaluate powers necessary and approaches for incorporating them into a viable management program; review management program elements to ensure that all necessary functions are addressed.
Select management actions; develop and implement a workable plan to achieve goals and objectives.	Identify selected management actions (program elements) for implementation and methods for incorporation. Solicit support and resources for implementation among stakeholders, regulators, the public, and internal/external funding organizations. Develop easily understood indicators that can be monitored by the community to determine trends. Activate or implement management practices/actions, targeting highest priority sites or areas for immediate action. Monitor progress via selected indicators; evaluate progress and adapt as necessary.

4.2 Where do I start?

Any individual or entity can initiate the management program development process. After the effort begins to move forward, a local government agency (e.g., county planning agency, health department) or private entity (e.g., citizen group, community assistance organization, service provider group) may take the lead in coordinating and leading the process. It is not unusual for a development company, lake association, sanitation district, or other organization to convene stakeholders to develop an onsite wastewater management program. The primary duty of this lead agency is to create a steering committee to spearhead the planning process. The steering committee should reflect community demographics in terms of geographic subareas, economic classes, political views, etc., and should be made up of people willing to sustain their participation for the duration of the process. Other attributes that need to be sought out in creating this committee are technical understanding, community outreach experience, fiscal/financial experience, legal background, and community organization experience, in addition to political leadership. The regulatory authority (e.g., local health department) is almost always a key stakeholder in the process. The ability to supplement committee membership as specific expertise is requested should also be built into the program. Olson, et al. (2002) characterize successful committees as those that:

- Understand the problems clearly before seeking solutions
- Take responsibility for and ownership of the problems
- Have members with strong leadership qualities
- Have a clearly defined vision, mission, and goal
- Take the time to identify and examine all options before making decisions
- Gather information from as many sources as possible in their examinations
- Keep all affected parties informed and involved during the process
- Identify and use appropriate decision-making criteria



4.2.1 *Starting a stakeholder group and building public support*

The lead agency must create an atmosphere in which all questions and ideas are heard and all proposals and problem solutions are worthy of evaluation. Developing a management program has not proven to be a simple task. Olson, et al., (2002) estimate that the entire management program development process in a small community may take from 2.5 to 7 years to complete. Starting the process as early as possible allows time to overcome the inherent resistance of citizens, elected officials, regulators, and engineers to the relatively new concept of an onsite/cluster wastewater management program. The only reason for delaying the process is to ensure that the problem is real and quantifiable, and that this information is fully understood by stakeholders before investigating and recommending solutions.

Figure 4-3: Schematic of the management planning process

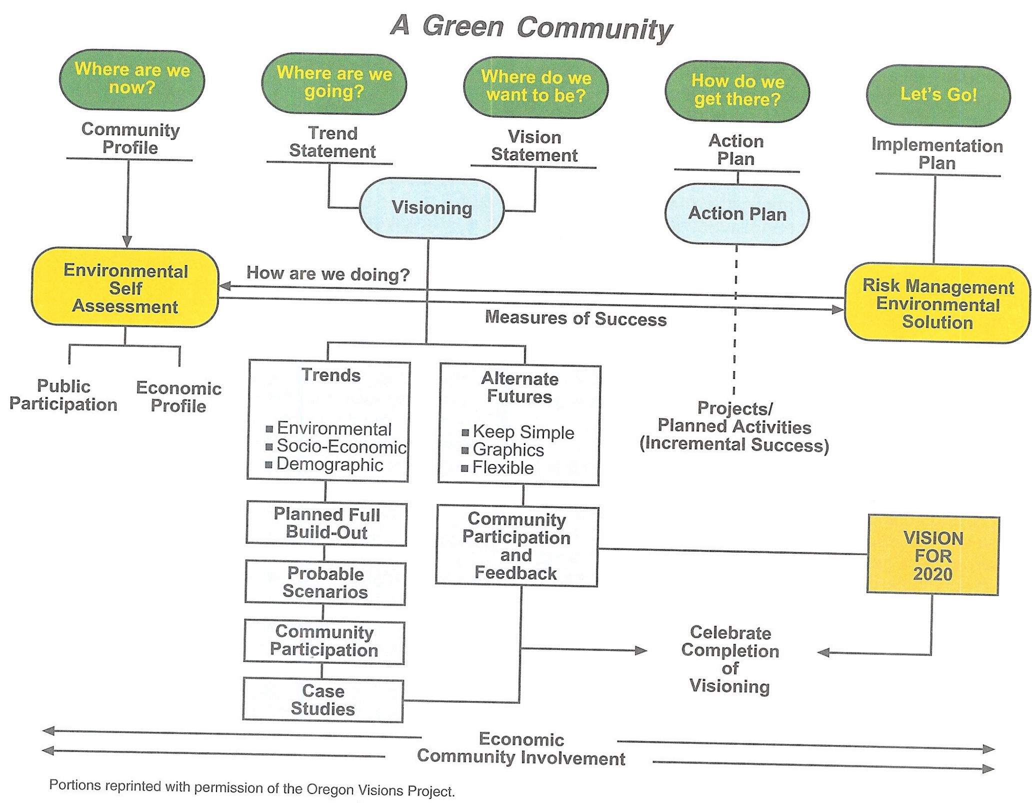


Figure 3-1. Green community flow chart (source: *http://www.epa.gov/region03/greenkit).*

4.2.2 *Responsibilities of the committee*

The steering committee's primary duties are to ensure that the community understands the problems, is willing to address them, and that resources are identified to support management program development. The committee's role is to develop the program and lead public outreach efforts to keep citizens and other important stakeholders informed. The community needs to be kept informed of committee progress and be assured that the committee receives citizen information gathered on a regular basis to assure the community of its role in the process. In conducting its outreach efforts to gain inputs from the entire community the committee needs to present the problems in a factual and straightforward manner, since hyperbole and exaggeration may undermine long-term credibility of the effort (Olson, et al.., 2002).

> "It is helpful that homeowners are kept aware and involved in any decision making process that affects their future, and more importantly, potentially costs them money. Individual homeowners need to feel that their input is being considered when community officials are involved in determining the future wastewater needs for their neighborhood."
>
> Novickis, 2001

A popular and useful exercise during the early stages of the process is to develop a community vision that incorporates quality of life, natural resource, and socioeconomic considerations into a statement supported by local people. Vision statements typically express qualitative goals for a community in somewhat general and perhaps superlative terms, but their real value lies in the process that created them. The very act of forging a common consensus for what the future should be is a powerful tool for groups to explore their values, consider competing interests, and build workable relationships that will make future tasks less contentious. In addition, suspending the program development process periodically to reflect upon the previously established vision provides a valuable opportunity to pause and consider common goals when conflict begins to build during group deliberations.

4.3.3 Public education and participation

If a new management program is to be created, a considerable public education and involvement process is required. Public outreach and involvement programs are keys to sustainable management entities (Allee, et al., 1999; Olson, et al., 2002; and Mancl, 2001). The entire community will be interested and perhaps somewhat concerned regarding the development of an onsite wastewater management program. Stakeholders from various agencies and citizen groups, including local homeowner associations, civic groups, local health departments, and other public agencies should be identified and involved in the program through advisory committees, program review groups, and other volunteer programs. If citizens and homeowners are brought into the process, they are more likely to be cooperative and feel they have a stake in the outcome. Groups concerned with economic growth (e.g., Chamber of Commerce, regional development and planning entities) should also be represented because onsite management programs will likely have an impact on residential and commercial development. Local groups interested in conservation and environmental protection and neighborhood associations are also good candidates for involvement. As many stakeholders as possible should be involved in all stages of management program development and operation so they can provide meaningful input and serve as program representatives in their dealings with other citizens.

> In the initial phase, the committee should:
>
> - Ensure that the community understands the problems being addressed
> - Relay community concerns back to the committee
> - Keep the potential management entity informed of committee decisions
> - Develop a preliminary profile of the community
> - Interpret data to assess health and environmental risk
> - Set the overall goals of the decentralized management program

Public involvement can be encouraged through small focus groups that explore perceptions, attitudes, opinions, and general knowledge; formal or informal outreach/inputs through direct mail or telephone surveys; advisory committees composed of an appropriate mix of stakeholders; or public meetings focused on important issues like proposed changes in regulations or fees. At a minimum the public education program should include approaches such as news updates in monthly or quarterly bills, frequent appearances at churches, schools, and other civic organizations, participation in festivals, fairs and other events, and formal public meetings and open houses. The exact nature of the water quality and/or public health problems problem and the conventional solution implications and costs should be widely disseminated to the stakeholders (e.g., citizens, officials, regulators) at the earliest possible time, along with the need to investigate lower-cost solutions that can also meet the needs of the community. Accomplishing these objectives requires an outreach program that builds awareness, provides educational information, and motivates action (see *Getting In Step: A Guide to Effective Outreach in Your Watershed* at http://www.epa.gov/owow/watershed/outreach/documents/).

Gaining support for management in Idaho

Because of burgeoning development pressures in the Idaho panhandle and the alarming rise in the Rathdrum Prairie Aquifer's nitrate concentration, the Panhandle Health District (PHD), which covers the state's five northernmost counties, developed a plan to implement an interim moratorium on new developments dependent on conventional septic tank soil absorption systems. The high nitrate problem had been traced through groundwater monitoring to the recent densely developed subdivisions, and agricultural sources had been shown to exhibit no such phenomenon. To gain support for the plan the PHD made presentations that documented the problem and the proposed solutions before school, civic, and professional groups. They also used radio and television ads. In all cases, the PHD attempted to craft the presentation contents and supporting materials specifically to the audience being addressed. All public presentations were conducted in a cooperative, rather than confrontational, manner.

Subsequently, the PHD formed an ad hoc citizen's committee to develop and present suggested changes to the preliminary policy developed by the PHD. This committee included representatives from the home builders, USDA-NRCS and two other impacted federal agencies, farmers, planning boards, the state legislature, the League of Women Voters, and conservation/environmental organizations. The committee members not only reached out to their respective constituencies, but also solicited feedback to the deliberative process. The committee submitted its comments and suggestions to the PHD, which followed them closely. The state approved the policy thereafter. The policy has been credited with shaping growth in the region, curbing urban sprawl, and helping the cities to strengthen public services. The public education and involvement process resulted in improved relationships among the citizens, the cities, and the regional authorities.

(Source: Prins and Lustig, 1988).

It is also critical to consider the views of existing system owners when planning inspection, monitoring, enforcement, and maintenance programs. During focus group sessions on system management options convened by Cornell University, participants identified "giving homeowners discretion in choosing inspectors" and "inspections required by mortgage lenders" as key recommendations for improving public acceptance of mandated management actions (Allee, et al., 1999). This report also notes that the creation of a decentralized wastewater management program is mostly about building relationships among the community citizens, community leaders, and the oversight agencies.

The process itself has many benefits in building trust and enforcing common goals. As proof of this the authors cite the fact that there are several long-term management entities with which all these parties are satisfied, and those that failed were attributed to inadequate communications and public involvement in the formation process. Mancl (2001) cited the four essential elements of a successful management program during the formation stage as: 1) resource protection (including public health and property values), 2) effective leadership, 3) creativity in establishing legal authority, and 4) good communications with residents. Providing adequate and sustainable legal authority, funding, and staffing have presented challenges for some new management entities, but the primary reason for failure of these entities has always been related to inadequate public involvement in the process (Allee, et al., 1999; Mancl, 2001; Olson, et al., 2002). Therefore, the public should be involved in planning and periodic reviews of simple or comprehensive management programs.

4.3 Identifying and evaluating monitoring and assessment information

After the steering committee has formally or informally organized and launched initial public education and outreach initiatives, it should begin to systematically identify and collect potentially useful existing data sources to create a community profile. This profile should, as a minimum, incorporate both the locations and types of systems displayed on lot plans, keyed into the area-wide maps of potential management implementation areas.

Inventories and assessments: an important first step

System inventories and impact assessments are vital for determining whether or not problems exist and the extent of those problems, if any. Inventories and assessments can be general surveys initially, with further study targeted at areas where problems might be indicated. The basic approach is to review all relevant factors in the community that are pertinent to wastewater planning, and to then use this information to identify problems and needs.

The assessment involves a comprehensive data gathering process on system locations, types, and functional status, along with information on ground water and surface water quality, reports from service providers and regulatory agencies, and local/regional planning information. The purpose of the assessment is to inventory all relevant factors in the community that pertain to wastewater planning, and to use this information to identify problems and needs. The information and processes necessary to conduct a community self-assessment will vary from community to community depending on available human, financial and technological resources.

The purpose of conducting a community self-assessment is to identify and evaluate the status of the community's current wastewater treatment and needs. A self-assessment process will help to identify problem areas in the community and suggest solutions for those problems. It will also help to clarify goals for decentralized onsite wastewater management that will lead to a cleaner, healthier future for the community.

Source: NESC, 2002

The primary value of the preliminary community profile is to form the basis for creating the technical, administrative, and financial plans for the management program. have to be determined in the subsequent phases of the process. Since original data are usually generated by consultants and are relatively costly, use of verifiable existing data should be maximized.

The initial step in conducting a community profile is to review official records of the existing onsite wastewater agency, usually the county or city health department, and other governmental entities such as the planning agency, economic development office, and county/city housing and taxing agencies. Other information sources should include source water protection assessments and watershed study reports from local water and wastewater utilities, state water quality agencies, and regional monitoring organizations. In addition, the committee should request information from private-sector service providers such as pumpers, onsite system designers, installers, well drillers, and other water-related professional service providers who are known to work in the area.

System inventory information is often non-existent or maintained in a format that does not allow easy interpretation, mapping, or analysis. Some jurisdictions have conducted residential/commercial surveys for information on all centralized and decentralized wastewater systems in the targeted region. A door-to-door survey approach, however, can be costly in terms of time and resources. Clermont County, Ohio, developed a decentralized system database by cross-referencing waterline and sewer service customers. By subtracting the latter from the former, the county identified 70 percent of the onsite systems and was able to use water system records to build an owner contact information database (Caudill, 1998).

Typical sources of data on systems, site conditions, and potential impacts include:

- Aerial photographs from state transportation departments, Natural Resource Conservation Service offices, and local utilities (see http://terraserver.homeadvisor.msn.com/)
- Census data (see http://www.census.gov)
- Prior plans for wastewater, drinking water, and other facilities (contact local utilities)
- Soils data from NRCS, service providers, and construction projects (see http://soils.usda.gov/)
- Topographic data from USGS and state or tribal sources (see http://www.usgs.gov/)
- Existing facilities; e.g., septage/residuals management capacity (contact local utilities)
- Land-use data from local and regional planning agencies (contact local agencies)
- Water quality data from public agencies (see http://cfpub.epa.gov/surf/locate/map2.cfm)
- Watershed information (see http://www.epa.gov/wateratlas/)
- Onsite system inventories (contact local septic system permitting agency)

These sources can be used to create a preliminary community profile. When necessary supplemental data are identified and generated, the resulting community profile can then be used to:

- Identify the technical elements of the environmental/public health problem
- Identify reasons for inadequate performance of existing systems
- Identify technological limitations based on natural/physical features of the community
- Evaluate impacts of community-growth decisions
- Estimate potential environmental and public health impacts of alternative solutions

Preliminary review of a management program survey by NESC indicates that most small management programs use property records, service provider records, billing/fee collection records, and permit records to generate their systems inventory. Although these sources are a good starting point, there is a need to be more comprehensive in creating an inventory during latter stages of program development, when specific management activities are defined. GIS and global positioning system (GPS) databases, census information, and other statistical summaries for the area should also be used where they exist. If performance standards are to be met by the managed area, the inventory should be verified by sanitary surveys or other house-by-house techniques if possible.

An excellent example of how an inventory was developed for the small village of Warren, Vermont, is described by Clark, et al. (2001). Numerous reports of onsite system failures in the narrow Mad River Valley site were amplified by revelations of high pathogen counts in the river, drinking water well contamination and flooding in the porous ledgerock setting. The village evaluated a central sewer system but rejected it because of the high costs, the lack of an acceptable treatment plant site, and required hook-ups for all 97 properties. A USEPA grant provided funding to document and evaluate (i.e., inventory) all the water and wastewater systems in the community using a GPS to create a database in a GIS format.

Mancl (2001) reviewed five long-term management entities with more than 20 years of experience. All five either already had a computerized database of onsite systems or were in the process of creating one. These management programs are located in Lake Panorama, IA, Crystal Lakes/Red Feather Lakes, CO, Auburn Lake Trails and Stinson Beach, CA, and Will County, IL. Orange County, NC, is attempting to convert their databases to GIS format, but at present lacks the funding to do so (Holdway, 2001). Greuel (2001) reported on the successful development of an internet-based O/M program for Wood County, WI.

Inventorying systems through electronic databases

A variety of public and private entities have developed databases to track wastewater system inventory, maintenance, and other information. Minimum data elements for system inventories include owner contact information, GIS location, installation date, technology type, and design flow. Optional data elements include site characterization information, designer, installer, management entity (if applicable), date of last service (pumping, inspection, repair), service provider, and operational status. The following public/private database systems provide useful examples of existing inventory and management options, are presented for information purposes only:

SepTrack, developed by the Buzzards Bay National Estuary Program in Massachusetts (http://www.buzzardsbay.org/septrfct.htm)

SepticPlanner, developed by Pamlico County, North Carolina (http://www.landplot.com/septic2.html)

SIMS (Septic Information Management System), developed by Stone Environmental, Inc. in Vermont (http://www.stone-env.com)

CASST (Computer Aided Septic System Tracking), developed by AppliTech, Inc. (http://www.casst.com)

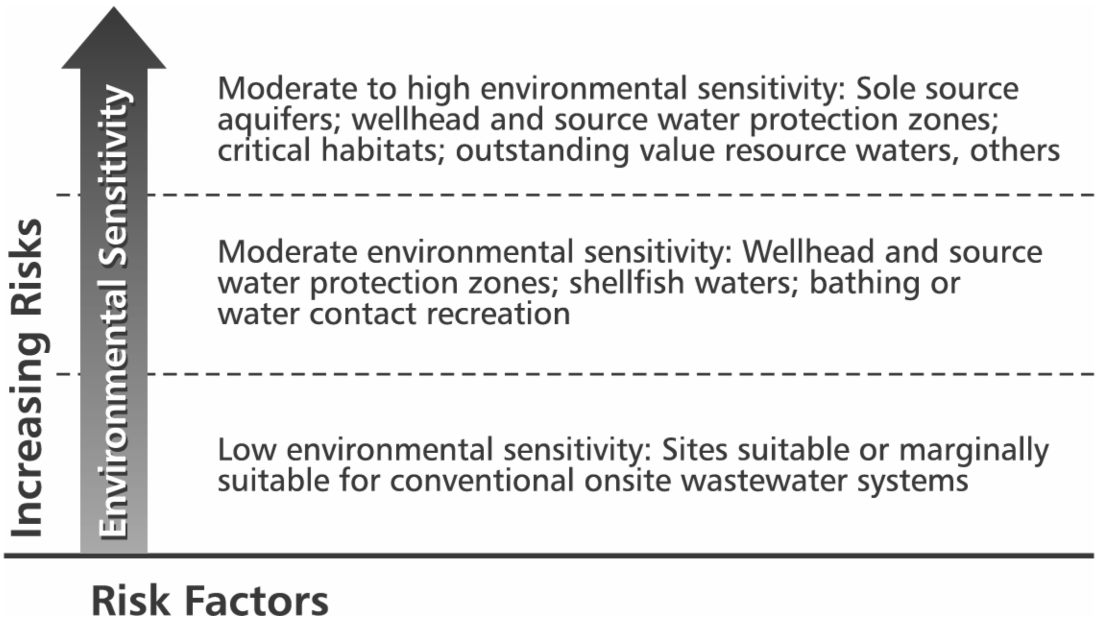
Carmody Waste Recording Services, developed by Carmody Data Systems Inc., (http://www.carmodydata.com)

Purdue University Onsite Wastewater Disposal Permit Database (http://danpatch.ecn.purdue.edu/~epados/onsiteOnline/database.htm)

4.4 Overview of risk factors related to system management

Treatment system management should be tailored to risks posed by those systems. Risks can be characterized and assessed by identifying key risk factors, such as environmental sensitivity, potential to threaten public health, wastewater characteristics, and treatment system complexity. Environmental sensitivity risk factors include water resource uses, such as drinking water sources, critical habitat, recreational waters, and other uses. The figure below illustrates risk potential relative to environmental sensitivity risk factors.

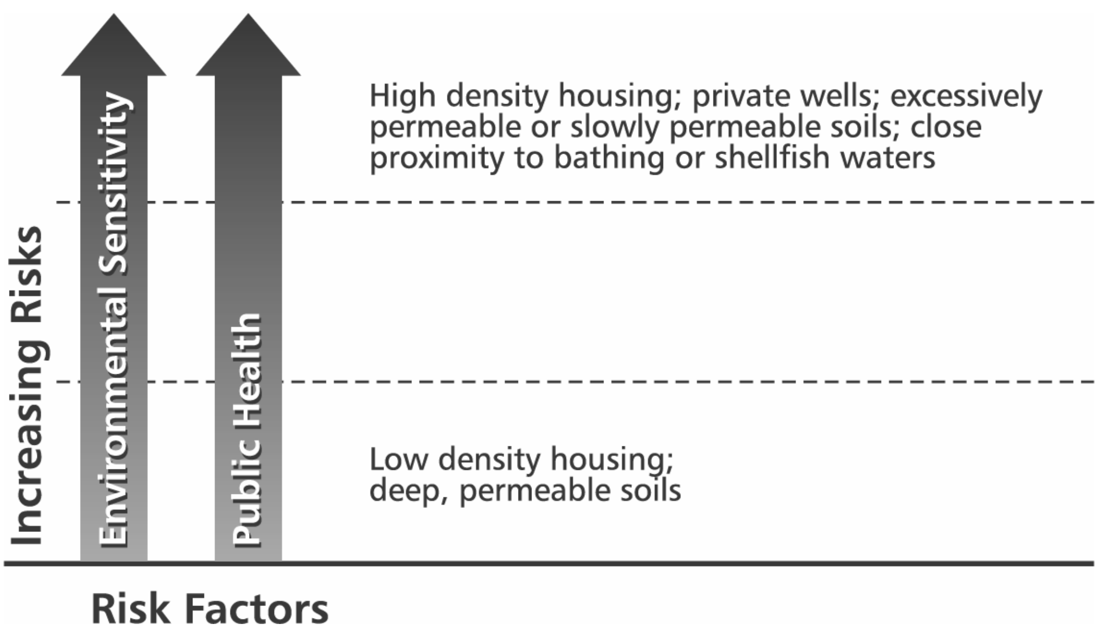
Figure 4-4. Environmental sensitivity risk factors



Source: Otis, 2002

Public health risk factors include system density, which increases wastewater loadings in concentrated residential areas; soil permeability, which affects treatment processes and effluent plume migration; and water resource uses (see figure below).

Figure 4-5. Public health risk factors



Source: Otis, 2002

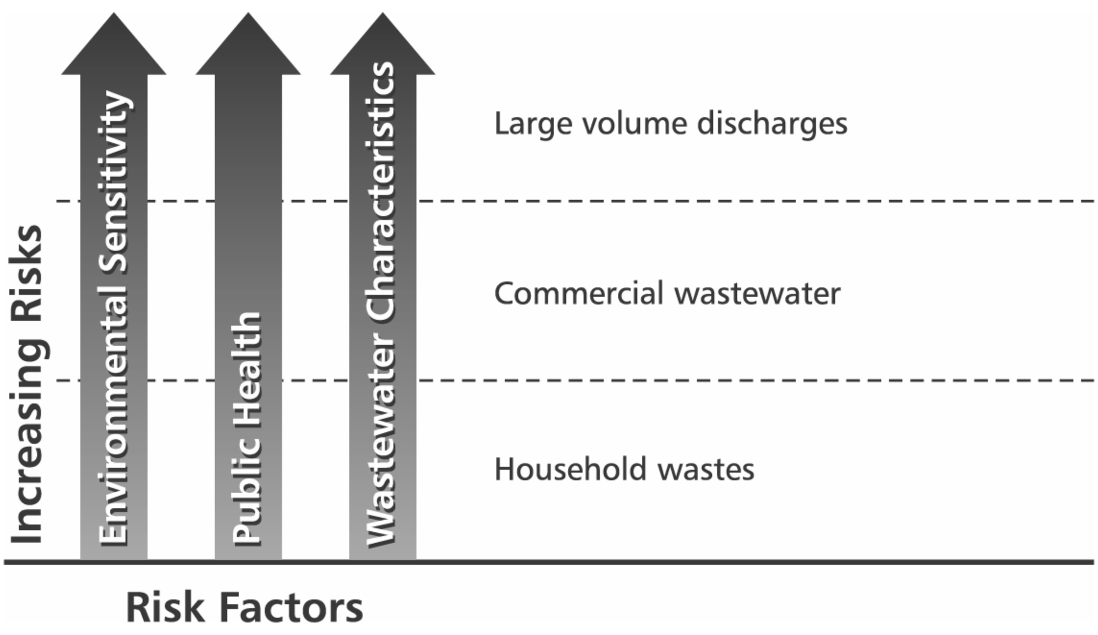
Nitrogen contributions from onsite systems

The San Lorenzo River basin in California is served primarily by OWTSs. Since 1985, the Santa Cruz County Environmental Health Service has been working with local stakeholders to develop a program for inspecting all onsite systems, assessing pollutant loads from those systems, and correcting identified problems. Studies conducted through this initiative included calculations of nutrient inputs to the river from onsite systems. According to the analyses performed by the county and its contractors, 55-60 percent of the nitrate load in the San Lorenzo River during the summer months came from onsite system effluent. Assumptions incorporated into the calculations included an average septic tank effluent total nitrogen concentration of 50 mg/L, per capita wastewater generation of 70 gallons per day, and an average house occupancy of 2.8 persons. Nitrogen removal was estimated at 15 percent for SWISs in sandy soils, and 25 percent for SWISs in other soils.

(Source: Ricker, 1994).

Wastewater characteristics also influence risk potential. For example, large volume discharges and commercial wastewaters can pose greater risk than lower volume domestic wastewater discharges due to greater effluent loadings to the soil or treatment system and higher concentrations of fats, oils, greases, sanitary waste, and other wastewater pollutants. The figure below summarizes risk potential relative to wastewater characteristics.

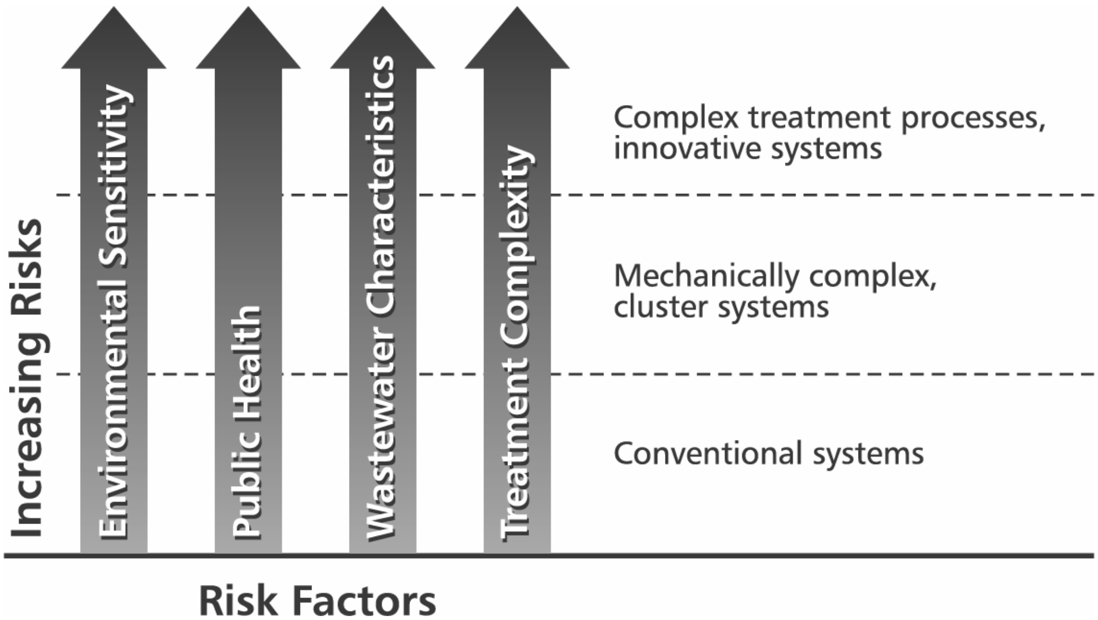
Figure 4-6. Wastewater characteristics risk factors



Source: Otis, 2002

Treatment system complexity risk indicators seek to differentiate between conventional, gravity-based soil infiltration systems – which require little maintenance beyond pumping every 3-5 years – and systems which incorporate electrical and mechanical components such as float switches, pumps, valves, pressure regulators, etc. The figure below illustrates risk factors related to treatment system complexity.

Figure 4-7. Treatment complexity risk factors



Source: Otis, 2002

The planning team can use inventory, environmental assessment, and risk information to group systems according to their relative potential to threaten public health or water resources. Under this approach, systems installed at high densities near valued water resources would rank higher in risk potential than those sited at lower densities farther away. Likewise, high volume commercial systems using complex technologies would receive a higher risk potential ranking than conventional, soil/gravity-based domestic systems. This approach suggests the development of risk potential "tiers" that may be characterized via a locally adopted scheme (e.g., high/medium/low) which can help to target the intensity of management. For example, some jurisdictions have identified areas near surface water or within other site-limited regions (e.g., areas with seasonally high water tables or excessively permeable/impermeable soils) as posing greater risks and therefore requiring greater management oversight. Areas without these limitations are targeted for less intensive management, and the areas in between are the focus of an intermediate menu of management activities.

Using GIS tools characterize potential water quality threats in Colorado

Summit County, Colorado, developed a geographic information system (GIS) to identify impacts that nitrates generated by onsite systems might have on water quality in the upper Blue River watershed. The GIS was developed in response to concerns that increasing residential development in the basin might increase nutrient loadings into the Dillon Reservoir. Database components entered into the GIS include geologic maps, soil survey maps, topographic features, land parcel maps, domestic well sampling data, onsite system permitting data, well logs, and assessors' data. The database can be updated with new water quality data, system maintenance records, property records, and onsite system construction permit and repair information. The database is linked to the DRASTIC ground water vulnerability rating model, and is being used to identify areas that have a potential for excessive contamination by nitrate-nitrogen from OWTSs. The assessments support system placement/removal decisions and help prioritize water quality improvement projects.

Source: Stark et al., 1999.

Such an approach is greatly enhanced by the availability of GIS mapping capabilities (see Colorado case study above). Baseline characterizations for larger groupings of homes (developments) should be done via GIS technology if possible because of its inherent ability for developing maps and other visual products that can help the community interpret data, assess risks, and make decisions to maximize the effectiveness of operating programs (USEPA, 2000). The potential benefits of GIS systems include the ability to project and analyze a variety of development, remediation, and other scenarios and to provide a real-time, dynamic and useable operating database for all of the management program's implementation and operation activities. These impact characterizations can also be approximated manually in the absence of GIS databases, and will likely be done that way for some time until GIS database coverage becomes more common. Many small communities contemplating managed decentralized systems will neither have this capability nor need it to move forward.

4.5 Using risk assessments to target management activities

A number of detailed risk assessment approaches for decentralized wastewater systems have been developed, and two are presented in this section to provide information on the basic processes that risk assessments follow. Hoover, et al.., (1998) have proposed a vulnerability assessment method that deals with soil-based systems and emphasizes public input. This approach considers risk assessment methods and management control strategies for both ground waters and surface waters. It uses three components of risk assessment and management:

- Valuation of receiving ground and surface waters as a public water supply or resource
- Vulnerability assessment of the water supply or resource
- Identification of control measures for minimizing risk

The first part of this approach involves a listing of the potentially impacted ground water and surface water resources in the watershed. Through community meetings and regulatory agency inputs a consensus is developed on the relative perceived value of each identified resource and the potential and perceived consequences of contamination. For example, a coastal community and its technical advisory team might determine that shellfish waters that are open to public harvesting are less important than public drinking water supply areas, but more important than recreational waters that might be used for body contact sports.

The second part of this risk assessment process is development of a vulnerability assessment matrix. One key measure of vulnerability of specific subarea is the ease with which pollutants can move vertically from the point of release (infiltrative surface) to the ground water. The vulnerability assessment matrix identifies areas of low, moderate, high, or extreme vulnerability depending on soil and groundwater aquifer conditions. For example, vulnerability might be high for coarse or sandy soils with less than 2 feet of vertical separation between the ground surface and the unconfined water table. Vulnerability might be low for silty soils with a vertical separation of greater than 10 feet. Each resource specified in the first part of the risk assessment process can be associated with each vulnerability category. A more detailed discussion of ground water vulnerability assessment is provided in National Research Council (1993).

The third part of this risk assessment process is the development of a management matrix that specifies a pre-treatment performance standard based on the water quality requirements for the use of receiving water. A matrix is developed for each identifiable subarea that reflects the quality of pretreated effluent that must be released to soil systems' infiltrative surfaces in that zone. All the subareas defined by vulnerability category relative to each water resource are included by category of pretreatment requirement (see Table 4-2).

Table 4-2. Resource listing, value ranking, and wastewater management schematic (see next page for treatment standards).

		Water supply		Water resource					
		Ground water		GW	Surface water				GW
		Site	Critical area	Regionally important aquifer	Primary recreation	Shellfish waters	Nutrient-sensitive	Secondary recreation	Poor aquifer
		Directly next to wellfield	Wellfield capture zone	Outwash sand & gravel	Beaches used for swimming	Commercial open waters	Lakes, ponds, rivers, etc.	Other surface waters	Unproductive confined aquifers
		Sites of community wellfields and source areas within 10 days' time of travel in the ground water to the community wellfields	Inner and outer critical areas that are within the ground water capture zones for the community wellfields	High-yielding surficial aquifers of regional importance that are used for many individual wells and that have rapid recharge	Source areas within 200 feet of frequently used swimming beaches	Source areas within 200 feet of shellfish waters that are open to public harvesting	Source areas for nutrient-sensitive surface waters that are susceptible to eutrophication or to loss of shellfish or finfish nursery areas due to nutrient inputs	Source areas within 100 feet of secondary recreational waters that are used for swimming on an unorganized basis	Poor, unproductive glacial till aquifers or productive aquifers isolated from the surface or not used for many private wells
Vulnerability Rating	**High**	R5	R4	R3	R3	R3	R2b	R2a	R1
	Mod.	R5	R4	R3	R3	R3	R2b	R1	R1
	Low	R5	R3	R3	R2a	R2a	R2b	R1	R1
Highest Value Resource Lowest Value Resource →									

Source: Hoover, et al., 1998.

Table 4-3. Proposed onsite system treatment performance standards in various control zones.

Standard	BOD (mg/L)	TSS (mg/L)	PO_4-P (mg/L)	NH_4-N (mg/L)	NO_3-N (mg/L)	Total N (% removed) [a]	Fecal coliform (CFU/1000 mL)
TS1 - primary treatment							
TS1u – unfiltered	300	300	15	80	NA	NA	10,000,000
TS1f – filtered	200	80	15	80	NA	NA	10,000,000
TS2 - secondary treatment	30	30	15	10	NA	NA	50,000
TS3 - tertiary treatment	10	10	15	10	NA	NA	10,000
TS4 - nutrient reduction							
TS4n - nitrogen reduction	10	10	15	5	NA	50%	10,000
TS4p - phosphorus reduction	10	10	2	10	NA	25%	10,000
TS4np - N & P reduction	10	10	2	5	NA	50%	10,000
TS5 - bodily contact disinfection	10	10	15	10	NA	25%	200
TS6 - wastewater reuse	5	5	15	5	NA	50%	14
TS7 - near drinking water	5	5	1	5	10	75%	<1 [b]

NA = not available.
[a] Minimum percentage reduction of total nitrogen (as nitrate-nitrogen plus ammonium nitrogen) concentration in the raw, untreated wastewater.
[b] Total coliform colony densities < 50 per 100 mL of effluent.

Source: Hoover et al., 1998.

Table 4-4. Control zone designations vs. treatment standards.

Verticle Separation Distance (feet)	Control Zone (with management entity)					
	R1	R2a	R2b	R3	R4	R5
	Treatment Perforamance Standard					
>4	TS1	TS1	TS1 OR TS4	TS1	TS2	TS4
3 to 4	TS1	TS1	TS1 OR TS4	TS2	TS2	TS5
2 to 3	TS1	TS2	TS2 OR TS4	TS3	TS3	NA
1 to 3	TS2	TS3	TS3 OR TS4	TS4	TS4	NA
<1	TS3	TS4	TS4	TS5	TS5	NA

Increasing Resource Value

Increasing Vulnerability

Otis (1999) has proposed a generally adaptable "probability of environmental impact" approach to determine onsite system impacts. This method was developed for use when resource characterization data are insufficient and GIS mapping data are unavailable for a more rigorous assessment. The approach is presented in the form of a decision tree that considers mass loadings to the receiving environment (ground water or surface water), population density, and the fate and transport of potential pollutants to a point of use (see case study box). The decision tree estimates the relative probability of water resource impacts from wastewater discharges generated by sources in the watershed. Depending on the state-defined designated use of the water resource, discharge standards for the treatment systems can be established. The community/management program can use these discharge standards to assemble appropriate treatment trains to meet those standards.

Establishing performance requirements by assessing the probability of impact

The "probability of impact" method estimates the probability that treated water discharged from an onsite system will reach an existing or future point of use in an identified water resource. By considering the relative probability of impact based on existing water quality standards (e.g., drinking water, shellfish water, recreational water), acceptable treatment performance standards can be established. The pollutants and their concentrations or mass limits to be stipulated in the performance requirements will vary with the relative probability of impact estimated, the potential use of the water resource, and the fate and transport characteristics of the pollutant (see Figure 1 and Table 4-6).

As an example, if the community/watershed assessment indicates that a ground water supply well that provides water for drinking without treatment might be adversely affected by an onsite system discharge and soils are assumed to be of acceptable texture and structure, with an unsaturated soil depth of 3 feet, nitrate-nitrogen and fecal coliform are two wastewater pollutants that should be addressed by the performance requirements for the treatment system (i.e., constructed components plus soil). With a relative probability of impact estimated to be "high," the regulatory agency considers it reasonable to require the treatment system to achieve drinking water standards for nitrate and fecal coliform before discharge to the saturated zone. The drinking water standards for nitrate and fecal coliform in drinking water are 10 mg/L for nitrate and zero for fecal coliform. Considering the fate of nitrogen in the soil, it can be conservatively expected that essentially all of the nitrogen discharged by the pretreatment system will be converted to nitrate in the unsaturated zone of the soil except for a few mg/L of refractory organic nitrogen. Because nitrate is very soluble and conditions for biological denitrification in the soil has not been determined, the performance standard for the onsite pretreatment system is set at 10 mg/L of total nitrogen prior to soil discharge. In the case of fecal coliform, the natural soil is very effective in removing fecal indicators where greater than 2 feet of unsaturated natural soil is present. Therefore, no fecal coliform standard is placed on the pretreatment (i.e., constructed) system discharge because the standard will be met after soil treatment and before final discharge to the saturated zone.

If the probability of impact is estimated to be "moderate" or "low," only the nitrogen treatment standard would change. If the probability of impact is "moderate" because travel time to the point of use is long, dispersion and dilution of the nitrate in the ground water may be expected to reduce the concentration in the discharge substantially. Therefore, the treatment standard for total nitrogen can be safely raised, perhaps to 20 to 30 mg/L of nitrogen. If the probability of impact is "low," no treatment standard for nitrogen is necessary. If the probability of impact is "high", but the point of ground water use at risk is an agricultural irrigation well, no specific pollutants in residential wastewater are of concern. Therefore, the pretreatment performance required need be no more than that provided by a septic tank.

Adapted from Otis, 2000.

Figure 4-8. Probability of environmental impact decision tree (see key, next page).

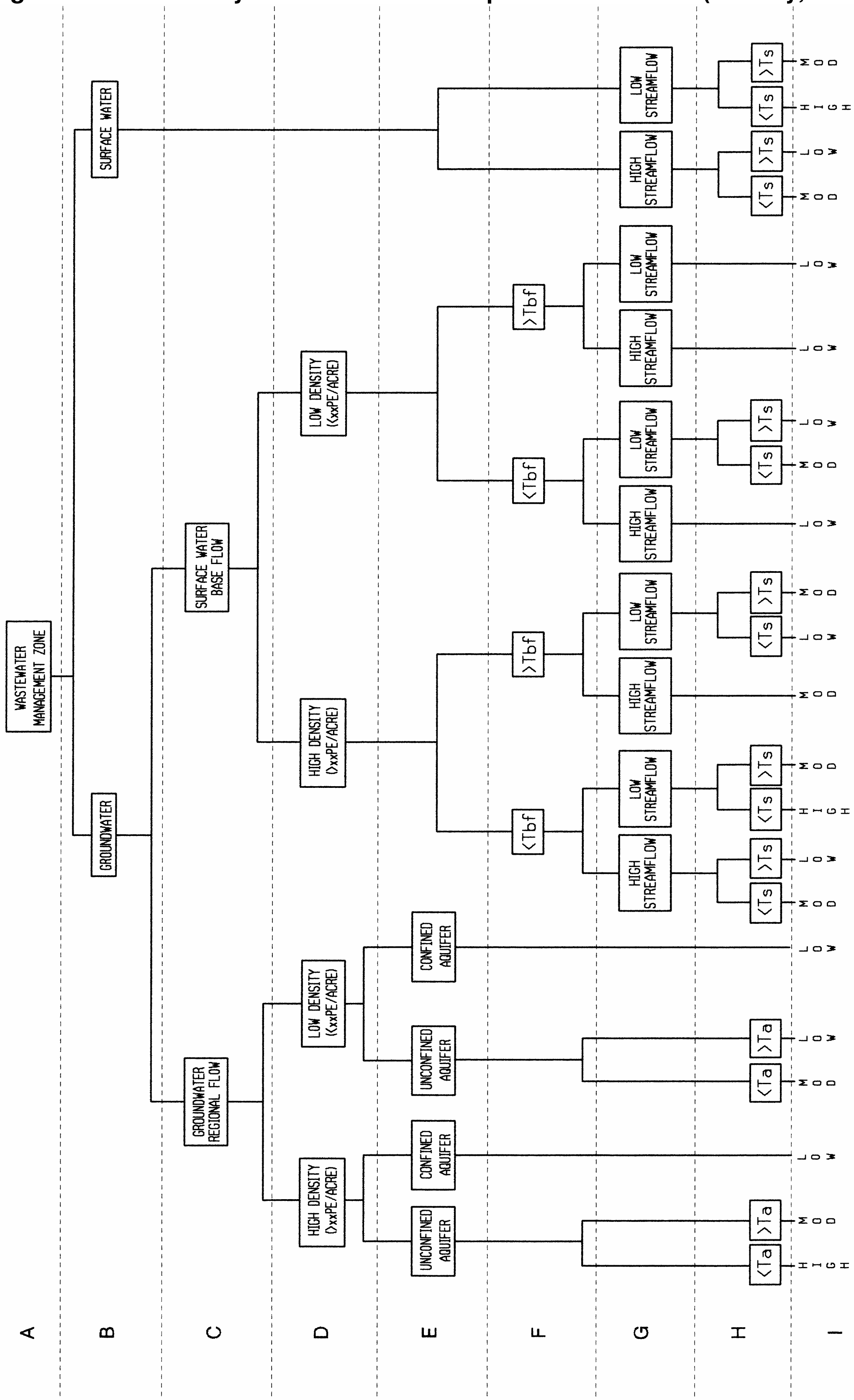


Table 4-5. Environmental sensitivity assessment key for preceding figure.

A	**Wastewater management zone** Includes the entire service area of the district.
B	**Receiving environment** Receiving water to which the wastewater is discharged.
C	**Fate of ground water discharge** The treated discharge to ground water may enter the regional flow or become base flow to surface water. Ground water flow direction can be roughly estimated from ground surface topography if other sources of information are not available. In some instances both regional flow and base flow routes should be assessed to determine the controlling point of use.
D	**Planning area density (population equivalents per acre)** The risk of higher contaminate concentrations in the ground water from ground water-discharging treatment facilities will increase with increasing numbers of people served. Where building lots are served by individual infiltration systems, the population served divided by the total area composed by contiguous existing and planned lots would determine population equivalents per acre (p.e./acre). For a large cluster system, the p.e./acre would be determined by the population served divided by the area of the infiltration surface of the cluster system.
E	**Well construction** Wells developed in an unconfined aquifer with direct hydraulic connections to the wastewater discharge have a higher probability of impact from the wastewater discharge than wells developed in a confined aquifer. Wells that are considered within the zone of influence from the wastewater discharge should be identified and their construction determined from well logs.
F	**Travel time to base flow discharge, T_{bf}** Treated wastewater discharges in ground water can affect surface waters through base flow. The potential impacts of base flows are inversely proportional to the travel time in the ground water, T_{bf}, because of the dispersion and dilution (except in karst areas) that will occur. Where aquifer characteristics necessary to estimate travel times are unknown, distance can be substituted as a measure. If travel time, T_{bf}, is greater than time to a ground water point of use, T_a, the ground water should be assumed to be the receiving environment.
G	**Stream flow** Stream flow will provide dilution of the wastewater discharges. The mixing and dilution provided are directly proportional to the stream flow. Stream flow could be based on the 7-day, 10-year low-flow condition (${}_7Q_{10}$) as a worst case. “High” and “low” stream flow values would be defined by the ratio of the ${}_7Q_{10}$ to the daily wastewater discharge. For example, ratios greater than 100:1 might be “high,” whereas those less than 100:1 might be “low.” Stream flow based on the watershed area might also be used (cfs/acre).
H	**Travel time to aquifer or surface water point of use, T_a or T_s** The potential impacts of wastewater discharges on points of use (wells, coastal embayments, recreational areas, etc.) are inversely proportional to the travel time. Except for karst areas, distance could be used as a substitute for travel time if aquifer or stream characteristics necessary to estimate travel times are unknown.
I	**Relative probability of impact** The relative probability of impact is a qualitative estimate of expected impact from a wastewater discharge on a point of use. The risk posed by the impact will vary with the intended use of the water resource and the nature of contaminants of concern.

Source: Otis, 1999.

4.6 Identifying goals for the management program

The inventory, assessment, and risk analysis activities described in the preceding sections provide information that can be used to develop goals for the management program. This information will likely identify areas where new development is occurring – and will occur in the future, groups of older systems believed to be failing, high-density system clusters, and critical areas near important ground water recharge zones or valued surface waters where greater management oversight might be needed.

Management programs generally support the twin goals of protecting human health and environmental resources. Developing management objectives and approaches for each group of systems – which may be organized as having high/moderate/low risk potential – will constitute much of the work in devising the overall management program. Many management programs have been developed to address direct threats to health or water resources, a trend that is likely to continue as state and local governments address water quality problems under the Clean Water Act TMDL program, the Source Water Protection provisions of the Safe Drinking Water Act (SDWA), and other state, tribal, and local rules. It is likely that water quality requirements will continue to drive calls for greater management of new and existing decentralized wastewater systems.

The questions that must be addressed during the goal-setting phase are the same as those addressed earlier in the community visioning phase. Those questions are:

- Where are we now?
- Where are going?
- Where do we want to be?
- How will we get there?

The particular management mix selected for an area should be based primarily on the potential for onsite system discharges to affect public health or the quality of surface and/or ground waters. The level of oversight incorporated into the management program should increase as the potential for negative impacts on public health or for environmental degradation increases. Examples of parameters to consider in assessing public health and environmental sensitivity include soil permeability, depth to groundwater, aquifer type, receiving ground and surface water use, proximity to sensitive surface waters, topography, geology, and density of development. Another useful parameter to consider is the "susceptibility determinations" that states, tribes, and local water utilities make as part of their source water assessments. These assessments determine which potential sources of pollution, including onsite wastewater systems, pose the greatest threats to potable water systems.

Other issues to consider that might directly impact public health and the local economy include the need to protect shellfish harvesting and direct contact recreational waters. An area far from any surface water with moderately permeable soils and a deep ground water table might be designated as an area of low public health risk and environmental sensitivity, whereas an area close to a sensitive surface water with excessively permeable soils and a shallow, unconfined ground water aquifer used directly (untreated) for drinking water might be designated as an area of high sensitivity. For those watersheds where a determination has been made that onsite wastewater systems are substantially contributing to a violation of the ground and/or surface water quality standards, higher level management will likely be needed. Also, systems that discharge to surface waters are subject to mandatory permitting and other requirements under state and federal National Pollutant Discharge Elimination Programs. Finally, decentralized systems that cause or contribute to violations of water quality standards (i.e., designated use attainment, water quality criteria) may be targeted for increased management through the Total Maximum Daily Load program of the Clean Water Act. More information on the pollutants of concern and their fate in soils and treatment systems is provided in the *Onsite Wastewater Treatment Systems Manual* (USEPA, 2001).

Table 4-6. Organizational, functional, and structural dimensions of management.

Issue	Questions to be addressed
Time frame	At what point will the planned management program structure be sustainable? If sequentially implemented, when will each sequence be completed? When will the management program be fully operational?
Service area	What areas will be served by the management program? Are these areas compatible with a local public jurisdiction that would have the necessary powers to make the program responsible and sustainable? Do specific subareas require different management approaches (e.g., system designs, staffing, regulatory controls)?
Purpose	What public health and water resource problems will be addressed and satisfied by the management program? What measurements must be made (monitoring) to verify success?
Structure	Can existing entities be modified or partnered to provide management services or will a new entity be needed? Should the management program be limited to decentralized wastewater treatment, or should other (e.g., water/stormwater) infrastructure be included? How will the program elements of the management program be staffed and administered? Will formal agreements, ordinances, or other legal mechanisms (e.g., articles of incorporation, public charter) be required to create structural elements of the management program?
Authority/liability	Which systems will be under the jurisdiction of the management program? Will the onsite treatment systems be privately or publicly owned? How will future wastewater systems be planned, designed, installed, operated, maintained, inspected, and repaired or replaced? What is the relationship between the management program and the regulatory authority? What formal agreements, ordinances, or other legal mechanisms (e.g., with system or property owners) are required to implement each element of the program? How will the program be funded?

(Adapted from Ciotoli and Wiswall, 1982).

The answers to the questions in Table 4-4 must be integrated into the best type of management program appropriate for the community. The relationship is between those answers and the 5 program models is depicted in Figure Y

4.6.1 Performance requirements

The establishment of performance requirements can be viewed as one of the most important determinants of the type of management program required. Performance requirements—derived from health and water resource assessments and risk evaluations conducted during the earlier planning phases—may define minimum requirements for addressing site evaluation, system design, construction and O/M complexity, and monitoring requirements. All of these, in turn, will impact the other program elements.

Under a performance-based approach that is driven by the quality of the receiving waters, site conditions and wastewater characterization information define the selection (design) of treatment technologies at each site. For known technologies with extensive testing and field data, the management agency can satisfy performance requirements prescriptively by designating pretreatment system components, design flow (i.e., system size), construction practices, materials to be used, acceptable site conditions, and design requirements. For example, the Arizona Department of Environmental Quality has proposed a rule that establishes definitions, permit requirements, restrictions, and performance criteria for a range of conventional and alternative treatment systems (Swanson, 2000).

Some states have already incorporated stricter site suitability and performance requirements into their OWTS permit programs. Generally, the stricter requirements were established in response to concerns over nitrate contamination of ground water supplies or nutrient inputs to surface waters. For example, in Massachusetts, the Department of Environmental Protection has designated “nitrogen-sensitive areas” in which new nitrogen discharges must be limited (see box below). Designation of these areas is based on ecological sensitivity and relative risk of threats to drinking water wells.

Performance requirements and system design in Massachusetts

Massachusetts' onsite regulations identify certain wellhead protection areas, public water supply recharge zones, and coastal embayments as nitrogen-sensitive areas and require OWTSs in those areas to meet nitrogen-loading limitations. For example, recirculating sand filters or equivalent technologies must limit total nitrogen concentrations in effluent to no more than 25 mg/L and remove a minimum of 40 percent of the influent nitrogen load. All systems in nitrogen-sensitive areas must discharge no more than 440 gallons of design flow per acre per day unless system effluent meets a nitrate standard of 10 mg/L or other nitrogen removal technologies or attenuation strategies are used.

Source: Massachusetts Environmental Code, Title V

4.7 Developing a management action plan

The development of an action plan—including information on costs and how it will be supported and implemented—will be based on the nature of the management program chosen by the community. Programs created through cooperative arrangements with partner organizations to enhance existing management approaches will depend on the synergy, commitment, and resources applied by stakeholders through the steering committee process.

The action plan should define the extent of each program element and identify how it will be implemented. Such a plan should bring into focus some ideas of the possible political conflicts, narrow the options of potential sources of the necessary powers of the management program, and allow some focusing on the possible technology and programmatic options before proceeding with implementation. Key issues to be discussed in the plan with appropriate stakeholder involvement and public outreach and feedback include the following:

- Investigate legal, jurisdictional, and regulatory restrictions

- Assess public health and natural resource protection ramifications
- Identify potential program partners and inventory available resources
- Plan to build public support through targeted outreach activities
- Establish performance requirements for treatment systems
- Identify appropriate onsite technologies for particular site conditions
- Establish operation/maintenance requirements for specific system types
- Develop cost estimates for actions under consideration
- Compare costs of various management and technology options
- Develop proposed income source(s) for each approach

A comprehensive wastewater management plan will summarize the optimal mixture of wastewater management options for different areas of a community based on the following:

- Current and future growth, population density, and land use patterns
- Natural characteristics (soil suitability for on-site systems, etc.)
- Economic characteristics
- Environmental conditions
- Current infrastructure
- Community preferences

(Source: Lombardo, 2001).

In addition, the action plan should include achievable milestones such as:

- Enabling legislation, ordinances, and regulations required (if applicable)
- Community referenda or other actions needed for approval
- Preparation and implementation of operating agreements, protocols, and easements
- Execution of all agreements with oversight agencies
- Reorganization of existing agencies and staffing of management entity

In considering which approaches might be most successful, Deese and Hudson (1980) suggest that all the alternative management structures that provide the necessary services and have the necessary powers should be arrayed and ranked according to the following criteria:

- Overall cost-effectiveness
- Relative distribution of costs and benefits
- Dependability, reliability and related risks in performance
- Public acceptability (i.e., in terms of cost, intrusiveness, etc.)
- Operability (i.e., based on "real world" projections)
- Land-use and development implications
- Other socioeconomic impacts

.

4.7.1 Determining management program boundaries

One key issue that must be addressed by the committee is the potential boundaries of any management program. If the boundaries are within a single township or county, that governmental entity may already have the authorities and resources to serve as an effective management entity. If not, or if traditional government entities decline to lead the program, other management institutional approaches will be necessary. If state statutes exist that permit the establishment of a special purpose district that either has the necessary powers or can attain them through partnering with a governmental entity, a workable structure can be created. The best approach in areas electing to operate less comprehensive programs might be a cooperative partnership among the present regulatory authority, planning offices, water quality agencies, service providers, and other stakeholders. Shephard (1996) recommends use of the simplest possible partnering arrangements to facilitate the process. This is where the state oversight agencies can be most useful in advising the community of the limitations of existing state statutes.

4.7.2 Develop an operating framework or institutional structure

Many management programs have developed in response to specific public health or water pollution problems, but many of these problems can be anticipated before they come to the attention of regulators. Keuka Lake, NY, is an example of a decentralized management program that was created to avoid problems that would have seriously impaired tourism if the present trends continued (Shephard, 1996). In either (reactive or proactive) case the community must decide what wastewater services must be provided to meet its goals. It must then develop the institutional structure with which to carry out these essential services. The institutional structure (an arrangement of public and/or private organizations) will constitute the mechanism for setting and enforcing regulations, performing decentralized system oversight activities such as inspections and record keeping, monitoring program performance, reporting to regulatory oversight agencies, and performing all the other activities identified in prior chapters of this Handbook

Management of cluster systems in Missouri

In Missouri, both the Department of Health and the Department of Natural Resources regulate wastewater treatment systems. The Department of Health regulates all single family residence wastewater systems and other sources of domestic sewage with a flow less than 3,000 gallons per day which discharge to the soil or holding tanks. The Department of Natural Resources (DNR) regulates systems with a flow of more than 3,000 gallons per day, systems treating industrial facilities, and all systems that discharge to surface waters except single family systems discharging to lagoons.

Clustered systems must be permitted by the DNR, which requires the designation of a “continuing authority” defined by state rules before an operating permit is issued. The continuing authority is a permanent organization responsible for the operation, maintenance, and upgrading of the facility. Missouri regulations regarding continuing authorities can be found at 10 CSR 20-6.010, Construction and Operating Permits, Continuing Authority (see http://www.sos.state.mo.us/adrules/csr/current/10csr/10c20-6a.pdf).

There is a hierarchy of acceptable continuing authorities, which are listed in preferential order in the regulation. If a system is built within the jurisdiction of a higher-order authority, a permit will not be issued to an organization lower in the preferred order unless the higher authority submits a letter that it does not want to own and operate the system. Homeowner’s associations are on the bottom of the preferential list. In recent years the legislature created the option of forming a nonprofit sewer company (see Missouri Revised Statutes, Chapter 398.825, at http://www.moga.state.mo.us/STATUTES/C393.HTM)).

Source: Smith, 2002

Development of onsite management functions within existing sanitation districts provides support for planning, installation, operation, maintenance, inspection, enforcement, and financing. Traditional onsite management entities (e.g., health departments) can partner with sanitation or other special districts to build programs with all the necessary powers. For example, a health department could retain its authority to approve system designs, issue permits, and oversee construction while the sanitation district could assist with regional planning and conduct inspections, maintenance (e.g., tank pumping and residuals reuse/disposal), and remediation. In some areas, special districts or private or public utilities have been created to manage the full range of onsite system management activities, from regional planning and system permitting to inspection and enforcement (Shephard, 1996; see Missouri case study).

For many jurisdictions, however, the concept of centralized management of decentralized systems is new and few resources are currently available to develop such a program. For those areas, a management partnership may provide the best program development and implementation option. In cases where significant problems are causing serious health or water quality threats or where new development provides an opportunity to initiate improved management, creation of a single management entity is likely to be justified.

The authority to perform all management functions might not be granted by existing state legislation to a single entity. Involving stakeholders who represent public health, environmental, economic development, political entities and the public in this process can ensure that the lines and scope of authority for an onsite systems management program are well understood and supported locally. The different governmental entities involved in the overall management program, especially for lower level programs, should have the combined authority to perform all necessary functions and should coordinate their activities through a relatively seamless approach. Thus, the management entity should have the following abilities (adapted from Venhuizen, 2001):

- Provide policy and management continuity
- Charge fees for services (e.g., book-keeping, inspections, etc)
- Compel users of the management services to comply with requirements (e.g., fines and incentives)
- Ensure sustainable financial and legal support and responsibility
- Hire and retain qualified employees
- Enter into contracts and undertake debt obligation
- Own, purchase, or lease real and personal property
- Have access to the systems managed

The management program is likely to be a *mix of approaches* under the *various program elements* and a *mix of approaches* in terms of *grouping and targeting systems for attention*. Consolidating as many management functions and activities as possible under a single program or entity is the most effective and efficient approach. In many basic management models (e.g., Program models 1 through 3) local health departments may become the management entity or may serve to coordinate the service provider and agency framework that comprises the management program. A Level 1 program may merely provide a means for better record keeping and public education, but it, like all effective management programs, must start with the development and maintenance of an inventory of existing systems on a central database.

4.8 Implementing and adapting the management program

Developing a sound, comprehensive wastewater management program involves consideration of applicable wastewater collection, treatment and dispersal technologies, and effective institutional arrangements. The mix of institutions, procedures, and arrangements involved in the management program development process will vary depending on local circumstances, environmental conditions, resources, and so on. Because of this diversity, the outcomes of management development efforts are likely to be different in different locations across the country.

In some towns or rural areas a decision might be made to develop an enhanced management strategy only for those systems presenting a clear and significant risk to valued water resources. For example, a coastal community might designate various management or treatment zones that have different performance requirements and management mandates, including regular inspections for near-shore properties that have a high potential for economic impacts on the community, (e.g., loss of recreation or tourism, commercial shellfish harvesting), while inland systems that pose less risk have less intensive management. Similarly, a rapidly urbanizing area might decide to require comprehensive, perpetual management of all systems serving new adjacent residential areas to prevent future demands that would result in far more expensive expansion of the existing wastewater infrastructure.

Successful creation of a management program involves devising a management partnership or entity capable of implementing selected actions and meeting established goals (see Table 4-6). Executing the action plan can be a challenge. Some tasks will proceed well, while others might require some adaptation. The adaptive management process—continuous improvement of strategies as new information, resources, or situational advantages become available—is both art and science, and involves a few key considerations in order to be useful:

- A set of baseline indicators of public health and environmental quality that can be easily monitored to verify the impact of the management program.
- Awareness of community perceptions and concerns through advisory boards and other feedback mechanisms that monitor the community.
- A process for collecting, analyzing, and acting on new information in reviewing the program and for reporting to state oversight agencies.
- Careful documentation and justification for actions, through widespread use of publicly-disseminated technical, administrative, and enforcement procedures and protocols

Adaptations are not necessary if potential pitfalls are identified and addressed early in the management program development process. NSFC (2001) cited the primary onsite management pitfalls to be: 1) inadequate funding, 2) suboptimal management program design, 3) lack of adequate inspection, monitoring and program evaluation capabilities, and 4) lack of public involvement and education. Mancl (2001) reported that the successful long-term management entities she evaluated all exhibited creative day-to-day problem-solving, empathetic staff, dependable financing, and good record keeping.

In the implementation phase, the committee should

- Monitor tasks to ensure that activities proceed according to schedule
- Track the effectiveness of cooperative arrangements and the management framework
- Adapt to new information and changing conditions as necessary

Preparing and implementing operating agreements, protocols, and easements should be a natural outcome of thorough public and oversight agency involvement in developing the action plan. The citizens and regulators have by this time seen all the alternatives and have agreed to the content of these necessary operating items. The difficulty in obtaining these approvals in official form should be directly related to the planning effort, (i.e., good planning should yield quick agreements).

If the plan creates a new management entity, the task of hiring capable and affable staff might be only the first step in a prolonged period of transferring responsibilities from existing agencies. If it was merely a consolidation or partnership of entities that have been involved in such programs, the lag time might be minimal. If, for example, a local regulatory agency (such as a health department) is enhanced to perform a wider array of duties (e.g., record keeping and public education), the staffing and organizational changes might be accomplished with a minimum of delay. Again, the thoroughness of the planning process has a major impact. If inventory development, protocol and enforcement program development, and enabling steps have been comprehensive, the problems with management program implementation and startup should be minimized. In cases where the implementation plan involves a significant amount of construction for immediate rehabilitation of problem systems or replacement of onsite systems in a densely populated area with cluster systems, the transitional stage could be extended because of innate time delays in contracting such projects. If the management program is implemented by a responsible management entity that performs many tasks through contracts to service providers, those contracts should be advertised and let at the earliest possible time, since these procedures have their own built-in timelines.

The Rhode Island Septic System Maintenance Policy Forum

For years, Rhode Island communities have worked to adopt septic system management programs. Despite many attempts, however, few programs materialized. Opposition typically included three arguments: 1) the state should stay out of its citizens' backyards, 2) upgrading septic systems is cost prohibitive, and 3) no agreed-upon maintenance or inspection standards exist.

To address these concerns comprehensively, the Rhode Island Department of Environmental Management (DEM) convened the Septic System Maintenance Policy Forum. The policy forum is a roundtable group that comprises approximately 100 representatives from federal, state, and local government, as well as private associations and citizens. It has met seventeen times since its inception in 1995, and routinely attracts 30 or more attendees per meeting. The policy forum operates on a consensus-based approach. Meeting coordinators characterize issues and suggest options, engendering debate and discussion until an agreement is reached.

Funding programs supported in part by the State Revolving Fund have been developed to provide low interest loans for system repairs and grants for community-wide management programs. Technical assistance is provided by DEM as requested. As of 2002, 83 percent of the communities in the state that rely extensively on decentralized wastewater systems are developing management programs. The forum also provided input for the new guide entitled *Septic System Check-Up: The Rhode Island Handbook for Inspection*. DEM developed the handbook, which describes two types of inspection: 1) a maintenance inspection to determine the need for pumping and minor repairs, and 2) a functional inspection for use during property transfer. The guide includes detailed instructions for locating septic system components, diagnosing in-home plumbing problems, and flow testing and dye tracing.

Source: Riordan, 2002

Possibly the most difficult issue to face during the planning phase is where to find financing for selected management approaches or actions. Community resource providers and consultants who specialize in small community projects for assistance generally have knowledge of various possible sources of financing and how to effectively apply for them. National resource providers like the Rural Community Assistance Project, the National Rural Water Council, and state extension services are generally equipped to provide this type of assistance, but many regional resources exist throughout the country that provide similar services. See Chapter 5 for a listing of financial, technical, and other resources to support decentralized wastewater programs.

Table 4-6. Institutional considerations in selecting a management entity

	State Agency	County	Municipality	Special district	Improvement district	Public authority	Public nonprofit corporation	Private nonprofit corporation	Private for-profit corporation
Responsibilities	Enforcement of state laws and regulations	Enforcement of state codes, county ordinances	Enforcement of municipal ordinances; may enforce state/county codes	Powers defined; may include code enforcement (e.g., sanitation district)	State statutes define extent of authority	Fulfilling duties specified in enabling instrument	Role specified in articles of incorporation (e.g., homeowner association)	Role specified in articles of incorporation (e.g., homeowner association)	Role specified in articles of incorporation
Financing capabilities	Usually funded through appropriations and grants.	Able to charge fees, assess property, levy taxes, issue bonds, appropriate general funds	Able to charge fees, assess property, levy taxes, issue bonds, appropriate general funds	Able to charge fees, assess property, levy taxes, issue bonds	Can apply special property assessments, user charges, other fees. Can sell bonds.	Can issue revenue bonds, charge user and other fees	Can charge fees, sell stock, issue bonds, accept grants/loans	Can charge user fees, accept grants/loans	Can charge fees, sell stock, accept some grants/loans
Advantages	Authority level and code enforceability are high; programs can be standardized; scale efficiencies	Authority level and code enforceability are high; programs can be tailored to local conditions	Authority level and code enforceability are high; programs can be tailored to local conditions	Flexible, renders equitable service (only those receiving services pay); simple and independent approach	Can extend public services without major expenditures; service recipients usually supportive	Can provide service when government unable to do so; autonomous, flexible	Can provide service when government unable to do so; autonomous, flexible	Can provide service when government unable to do so; autonomous, flexible	Can provide service when government unable to do so; autonomous, flexible
Disadvantages	Sometimes too remote; not sensitive to local needs and issues; often leaves enforcement up to local entities	Sometimes unwilling to provide service, conduct enforcement; debt limits could be restrictive	Might lack administrative, financial, other resources; enforcement might be lax	Can promote proliferation of local govern-ment, duplication/frag mentation of public services	Contributes to fragmentation of government services; can result in administrative delays.	Financing ability limited to revenue bonds; local government must cover debt	Local governments might be reluctant to apply this concept	Services could be of poor quality or could be terminated.	No enforcement powers, company might not be fiscally viable; not eligible for major grant/loan programs

(Source: Ciotoli and Wiswall, 1982).

Almost all of the decentralized management programs that have been identified are for small developments, and most are for onsite systems only. Since clusters of significant size are often considered community-wide systems, their management is often categorized under conventional central sewers and is difficult to identify when performing searches to identify decentralized systems. Thus, the best documentation of existing information is still under development by the NESC. This preliminary information indicates that management programs that have been tentatively identified have small budgets and are modest in terms of coverage by the discussed program elements. Almost all total budgets were less than $1 million; the mode was only $5,000. The majority of the actual management programs are supported at least in part by user fees. Other key support mechanisms are operational fees and property taxes either as exclusive or as part of the overall funding package. User fees are primarily construction permit, operating permit, and inspection fees paid by system owners, but contractor (service provider) licensing fees are also significant.

The few studies of management programs provide a widely varying picture of management program costs versus services provided. Possibly the best single report is by Mancl (2001). The report, which attempted to compare five long-term management programs, failed to show any pattern of costs and services. Combining the report with some other case studies, however, does offer some insights. For example, throwing out some obvious outliers, a responsible management entity (Management Programs 4 and 5), which often include cluster systems, appears to cost homeowners somewhere between $180 and $450 per year. This cost may not include certain one-time costs to join or costs for special services. In contrast, minimal management programs (similar to Management Program 1) appear to cost less than $100 per year. Intermediate management programs vary widely between these extremes depending heavily on what is included in the fees charged, other sources of funding, and the technologies employed.

Lake Panorama, Iowa: developing a flexible management model

This management program began in 1980 through County ordinance changes and administrative rules approval and started with creating and implementing specific design requirements that exceeded those of the state code because of economic and water quality concerns. The boundaries are totally within the County, thus making the establishment of the management program. All new systems were sited, designed and constructed according to these more stringent requirements at the start. As-built drawings and descriptions of these systems were entered into the database. Existing systems were then located, inspected, upgraded, and entered into the database/inventory. A regular inspection program (originally, every 3 years for full-time and every-six for seasonal residents, but now reduced to 1 and 2 years, respectively) conducted by the County sanitarian was instituted. The County health agency provides oversight of the program by appointing the program's board of directors, but homeowner association input is obvious and welcomed in all aspects of the program operation.

The program could be characterized as a Model Program 3 without the specific use of operating permits. Inspections are required at specific intervals and enforcement of any deficiencies found through them is clear and locally-encoded. Prescriptive site evaluation procedures and design requirements are more stringent than state code requirements. Hydraulic failures have been reduced to about 1 percent. The funding is to implement the program is raised through property taxes by the County, as the legal taxing authority. Participation is essentially mandatory for all homeowners. Presently, the cost is about $30/year per home with an onsite system for inspections and inventory updating. Operation and maintenance costs must be added to determine the total cost for each home. Some dwellings are on cluster systems, and they are assessed an additional $600/year or more.

Mancl and Patterson, 2001

Regarding the fundamental financial, managerial, and technical analyses that are required for consideration in becoming a decentralized wastewater "responsible management entity" (e.g., electricity providers, water/sewer providers, or public sector entities), some excellent guidance on basic business decisions exists (Drake, 2001; Yeager, 2001; and English and Yeager, 2001). Since these management programs are often considered to be business-oriented, business plans must be approved that show financial viability in perpetuity for these entities. Drinking water suppliers have also become aware of the need for this viability in recent years after experiencing some of the legal, financial, and public health consequences of failing to do so.

The community may also seek information on the concept of centralized management of decentralized systems through information centers like the NESC, which is developing a series of non-technical tools designed to assist the community at each of the steps in this process. Handbook readers should visit http://www.nesc.wvu.edu/nsfc/nsfc_index.htm on the Web for further information on the availability of these products. Publicly financed support for centralized wastewater treatment services has been available for decades from federal, state, and local sources. Since 1990, support for public funding of onsite treatment systems has been growing. (See Appendix A for a summary of the most prominent sources of grant, loan, and loan guarantee funding.)

4.9 Regular review and revision of an ongoing management program

Management entities or cooperative program steering committee members should regularly review inspection and monitoring data, state or tribal water quality monitoring data, customer complaints, fee structures, and data to track progress of the management program in achieving goals and objectives. Although an annual review is most likely, the management program should have the capability to make interim adjustments in response to unanticipated problems that arise during the course of normal operations.

Evaluating the effectiveness of onsite management program components (e.g., planning, fiscal, regulatory, service provider certification) can provide valuable information for adapting program provisions and execution approaches. A regular and structured evaluation of any program can provide critical information for program managers, the public, and decision makers. Periodic program evaluations should be performed to analyze program methods and procedures, identify problems, evaluate the potential for improvement through new technologies or program enhancements, and adjust program goals. The program evaluation process should include:

- A tracking system for measuring success and evaluating/adapting program components
- Processes for comparing program achievements to goals and objectives
- Approaches for adapting goals and objectives if internal or external conditions change
- Processes for initiating administrative or legal actions to improve program functioning
- An annual report on the status, trends, and achievements of the management program
- Venues for ongoing information exchange among program stakeholders

A variety of techniques and processes exist to perform program evaluations to assess administrative and management elements. The method chosen for each program will depend on local circumstances, the type and number of stakeholders involved, and the level of support generated by management agencies to conduct a careful, unbiased, detailed review of the program's success in protecting health and water resources. Regardless of the method selected, the program evaluation should be performed at regular intervals by experienced staff with involvement by program stakeholders.

Suggested approach for conducting a formal program evaluation

Form a program evaluation team composed of management program staff, service providers, public health agency representatives, environmental protection organizations, elected officials, and interested citizens.

Define the goals, objectives, and operational components of the various onsite management program elements. This can be done simply by using a checklist to identify which program elements currently exist and whether or not they are meeting their objectives.

Review the program elements checklist and feedback collected from staff and stakeholders to determine progress toward goals and objectives, current status, trends, administrative processes used, and cooperative arrangements with other entities.

Identify program elements in need of improvement, define actions or amount and type of resources required to address deficient program areas, identify sources of support or assistance, and implement recommended improvement actions.

Communicate suggested improvements to program managers, to ensure that the findings of the evaluation are considered in program structure and function.

A number of state, local, and private organizations have implemented performance-based management programs for a wide range of activities, from state budgeting processes to industrial production operations. The purpose of these programs is twofold: linking required resources with management objectives and continuous improvement. Onsite management programs should use the expertise present among partnering entities to develop and implement in-house evaluation processes (see case study).

Performance-based budgeting in Texas

Since 1993 state agencies in Texas have been required to develop a long-term strategic plan that includes a mission statement, goals for the agency, performance measures, an identification of persons served by the agency, an analysis of the resources needed for the agency to meet its goals, and an analysis of expected changes in services due to changes in the law. Agency budget line items are tied to performance measures and are available for review through the Internet. Information on the budgeting process in Texas is available from the Texas Legislative Budget Board at http://www.lbb.state.tx.us.

Source: Texas Senate Research Center, 2000.

4.10 Using the management models as a basis for management

The five management models described in Chapter 3 provide a workable template for building a management program (see Figure 4-9 and Appendix D). Management Model 1 – Homeowner Awareness – is suggested as the starting point for any management program, since it stresses system inventories, public education, and homeowner awareness/responsibility for system operation and maintenance. Management Model 2 provides further enhancement through the addition of operation and maintenance contracts between the system owners and service providers. The relationship to the regulatory authority is still the same, but the management program has better control of the management of more complex onsite systems to review in its oversight activities.

Management Model 3 systems (i.e., with operating permits) may consist of enhanced partnerships among public/private entities and the local regulatory authority. However, the management structure and its capabilities must be more sophisticated because it oversees inspections and operating permits for onsite systems within its boundaries. Also, the public education and involvement aspects should be enhanced, since more enforcement is likely when operating permits, inspections, system performance monitoring, and more sophisticated record keeping are involved.

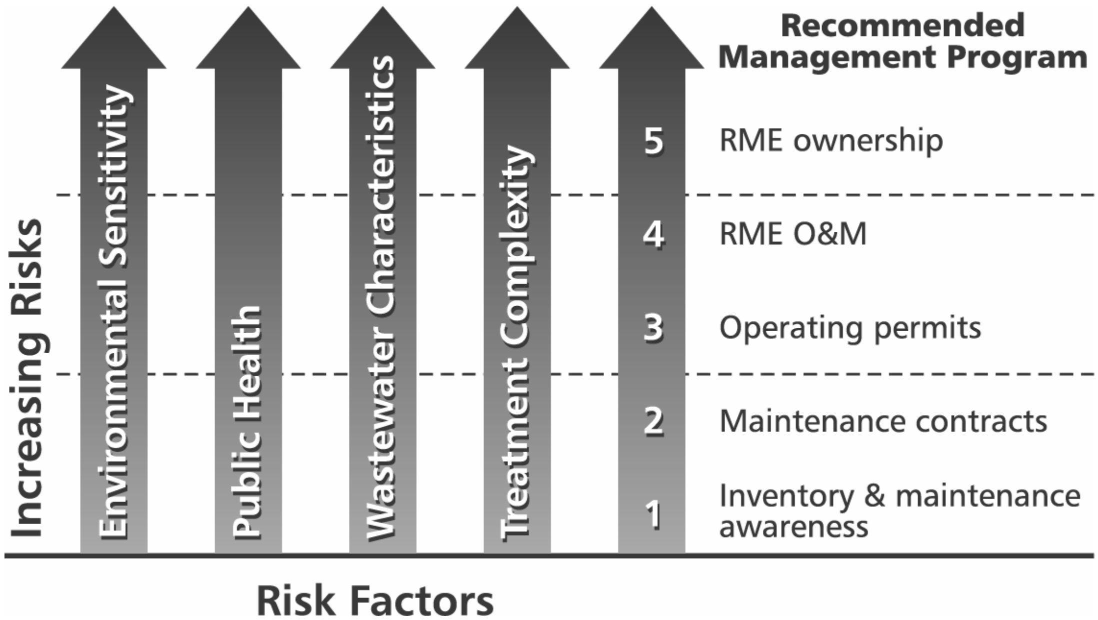
With clearly defined "responsible management entities" (i.e., under Management Models 4 and 5), there may be major changes in interagency relationships. Enabling legislation for creation of third party onsite wastewater management entities will vary, and cause some variation in the role of the traditional regulatory authority (e.g., local health department). The management of cluster systems will bring more oversight from the state environmental agency as well the state health department. In most cases, at least some of the inherent regulatory program responsibilities, (e.g., permitting, training and certification/licensing of service providers), may either be delegated to or shared with the responsible management entity (RME). An RME must be quite sophisticated in its technical capability and records management. It will normally, as negotiated with the oversight agencies, bear some responsibility for developing and administering service-provider protocols, conducting monitoring and inspection programs, and arranging supplemental training for service providers.

Performance must be ensured more proactively through oversight of design and installation, performance of inspections, and monitoring of operating systems and the receiving environment, and in oversight of the residuals management program. The RME must also be responsible for meeting any permits issued to it by the oversight agencies. It has all the necessary capability (legal, financial, and administrative) to devise internal plans to incorporate and operate cluster wastewater systems and play an active role in regional land use planning. Both types of RMEs can enter into contracts with licensed/certified service providers to implement any part of its overall service needs, which is a typical approach to lower costs. The RME must , however, also have the technical resources to oversee the performance of its contractors since it is ultimately responsible to the oversight agencies in accordance with its permits.

It is important for the committee to note that implementing higher overall levels of management can be accompanied by significantly increased public opposition, especially if the community and important stakeholders (e.g., system owners) are not sufficiently involved in developing the set of enforcement actions and fee structures. Herring (2001) noted that in the absence of clearly perceived benefits, such as resolving severe water quality problems associated with a valued resource, little public support can be expected for increased management. Development of a RME appears to be an attractive alternative only under the following conditions (Herring, 2001):

- There is a serious threat to property values, and a management district is projected to be able to reduce the impact at a lower cost than central sewers.
- There is a widespread perception of a threat to public health or the environment and a perception that central sewers would be more expensive.
- The area is undergoing significant new development, and the formation of a management entity is part of an overall development package.

Figure 4-9. Using risk inputs to select a management program model.



Source: Otis, 2002.

The robustness of the decentralized wastewater system technology has a major influence on the type of management program selected. Proper application of the normally prescriptive elements of the regulatory code under Management Model 1 should be sufficient to minimize the hydraulic backup problems resulting from unmanaged application of that code in areas where environmental concerns are minimal and improved public health protection from direct human contact is the goal of the program. A more complex treatment system, such as a surface discharging aerobic system with filtration and disinfection, will require frequent monitoring and attention from a professional technician to maintain its performance, and therefore requires a higher level of management.

Integrating public and private entities in watershed management

In 1991 the Keuka Lake Association established a watershed project to address nutrient, pathogen, and other pollutant loadings into the upstate New York lake, which provides drinking water for more than 20,000 people and borders 8 municipalities and two counties. The project sought to assess watershed conditions, educate the public on the need for action, and foster inter-jurisdictional cooperation to address problems. The Keuka Watershed Improvement Cooperative was conceived by the project team as an oversight committee composed of elected officials from the municipalities and counties. The group developed an 8-page inter-municipal agreement under the state home rule provisions, which allow municipalities to collectively do anything they can do individually, to formalize the cooperative and recommend new laws and policies for onsite systems and other pollutant sources.

Voters in each municipality approved the agreement by landslide margins after an extensive public outreach program. The cooperative developed regulations governing onsite system permitting, design standards, inspection, and enforcement. The regulations carry the force of law in each town or village court and stipulate that failures be cited and upgrades required. Inspections are required every 5 years for systems within 200 feet of the lake and alternative or aerobic systems must be inspected annually. The cooperative coordinates its activities with state and county health agencies and maintains a GIS database to track environmental variables and the performance of new technologies. The program is financed by onsite system permit fees, some grant funds, and appropriations from each city's budget.

(Source: Shephard, 1996).